What is Claimed Is:

1. A pressurized water reactor comprising:

a containment structure;

a reactor pressure vessel containing reactor coolant mounted in the containment structure;

a reactor core mounted in the reactor pressure vessel in the pool of reactor coolant;

at least one steam generator immersed in the reactor coolant in the reactor pressure vessel and having a secondary circuit extending outside the reactor pressure vessel and the containment structure;

a heat exchanger positioned outside the containment structure and connectable for emergency cooling to the secondary circuit to circulate cooling fluid through the secondary circuit to extract heat from the reactor pressure vessel in the event of a loss of coolant accident resulting in mass flow of reactor coolant from the reactor pressure vessel into the containment structure; and

the containment structure and the heat exchanger being sized to reduce pressure in the reactor pressure vessel to a reduced pressure below the pressure in the containment structure to reverse the mass flow from the reactor pressure vessel within no more than about 3 hours of the loss of coolant accident whereby the reactor core remains covered without the addition of water from other sources to the reactor vessel.

2. The pressurized water reactor of Claim 1 wherein the containment structure is spherical.

3. The pressurized water reactor of Claim 1 wherein the containment structure is filled with gas and includes at least one suppression tank containing a volume of water and gas into which the gas in the containment structure and steam escaping into the containment structure from the reactor pressure vessel are directed and the steam is condensed, the volume of water and gas in the at least one suppression tank being sized to allow pressure in the containment structure to achieve a pressure which does not exceed containment structure design pressure such that the heat exchanger can remove sufficient heat to reduce the pressure in the reactor pressure vessel to less than the pressure in the containment structure.

heat exchanger can remove sufficient heat to reduce the pressure in the reactor pressure vessel to less than the pressure in the containment structure.

4. The pressurized water reactor of Claim 3 wherein the reactor pressure vessel has a lower portion in the which the reactor core is mounted and the containment structure includes a flood-up cavity in which the lower portion of the reactor pressure vessel is located, and a transfer path for the transfer of water in the at least one suppression tank into the flood-up cavity as pressure in the containment structure falls by the gas in the at least one suppression tank compressed during condensing of the steam by the gas added from the containment structure.

5. The pressurized water reactor of Claim 4 wherein the containment structure includes a pressure well connected to a gas space in the at least one suppression tank and in which the gas is compressed and stored.

6. The pressurized water reactor of Claim 4 in which the at least one suppression tank is supported in the containment structure above the reactor core and the containment structure further includes piping selectively directing water in the at least one suppression tank to flow by gravity from the at least one suppression tank into the reactor pressure vessel to assure coverage of the reactor core with water.

7. The pressurized water reactor of Claim 6 wherein the at least one suppression tank contains a device discharging the gas in the containment structure and the steam escaping into the containment structure into the volume of water in the at least one suppression tank, the device being positioned in the at least one suppression tank below the level of water in the at least one suppression tank at a height selected to provide for transfer of a first predetermined portion of the volume of water in the at least one suppression tank above the device to the flood-up cavity while maintaining a second portion of the volume of water in the at least one suppression tank below the device for gravity feed to the reactor pressure vessel.

8. The pressurized water reactor of Claim 3 in which the at least one suppression tank is supported in the containment structure above the reactor core and the containment structure further includes piping selectively directing water in the at least one suppression tank to flow by gravity from the at least one suppression tank into the reactor pressure vessel to assure coverage of the reactor core with water.

9. The pressurized water reactor of Claim 3 in which the reactor pressure vessel has a lower portion in which the reactor core is supported and the containment structure includes a flood-up cavity in which the lower portion of the reactor pressure vessel is located, and wherein the at least one suppression tank is supported in the containment structure above the reactor core, the containment structure further including a transfer path selectively directing water from the at least one suppression tank into the flood-up cavity.

10. The pressurized water reactor of Claim 3 wherein the reactor pressure vessel has a lower portion in which the reactor core is mounted, and the containment structure includes a flood-up cavity in which the lower portion of the reactor pressure vessel is located, a transfer path for transferring water from the at least one suppression tank to the flood-up cavity to fill the flood-up cavity to a level above the reactor core, and a flow path from the flood-up cavity to an elevation in the reactor pressure vessel above the reactor core by which water in the flood-up cavity can flow by gravity into the reactor pressure vessel and keep the reactor core covered, thereby providing additional reactor core cooling different from cooling provided by the heat exchanger and the secondary circuit of the at least one steam generator.

11. The pressurized water reactor of Claim 1 wherein the containment structure has a flood-up cavity in which a lower portion of the reactor pressure vessel containing the reactor core is located and the containment structure is constructed of steel and includes a shroud directing a flow of cooling fluid over the exterior surface of the containment structure to provide a diverse source of cooling for the containment structure whereby steam is condensed on the internal surface of the containment structure and returns to the reactor vessel flood-up cavity where it is available for cooling the reactor core.

12. The pressurized water reactor of Claim 1 wherein an upper portion of the reactor pressure vessel has a depressurization path operable to vent steam from the upper portion of the reactor pressure vessel into the containment structure to ensure equalization of pressure between the reactor pressure vessel and the containment structure at a rate such that following a break in a lower portion of the reactor pressure vessel, reactor pressure vessel water level does not fall below the top of the reactor core.

13. The pressurized water reactor of Claim 1 wherein the secondary circuit is designed for the same pressure and temperature as the reactor pressure vessel.

14. A pressurized water reactor comprising:

a containment structure having a flood-up cavity;

a reactor pressure vessel containing a pool of reactor coolant mounted in the containment structure with a lower portion located in the flood-up cavity;

a reactor core mounted in the lower portion of the reactor pressure vessel in the pool of reactor coolant;

at least one steam generator immersed in the pool of reactor coolant in the reactor pressure vessel;

at least one suppression tank mounted in the containment structure and containing a volume of water through which steam escaping into the containment structure from the reactor pressure vessel as a result of a loss of coolant accident is introduced and condensed; and

a transfer path selectively transferring water in the at least one suppression tank from the at least one suppression tank to the flood-up cavity.

15. The pressurized water reactor of Claim 14 wherein the containment structure contains a gas and the transfer path includes a pipe extending down into the volume of water in the at least one suppression tank through which the escaping steam from the reactor pressure vessel together with the gas in the containment structure is introduced into the water in the at least one suppression tank and through which gas compressed in the at least one suppression tank during the condensing of the steam drives water from the at least one suppression tank for transfer to the flood-up cavity.

16. The pressurized water reactor of Claim 15 wherein the containment structure includes a pressure well connected to the at least one suppression tank for storing at least some of the gas compressed in the at least one suppression tank.

17. The pressurized water reactor of Claim 15 wherein the at least one suppression tank is mounted above the reactor core and the at least one

suppression tank has piping for selectively transferring water from the at least one suppression tank to the reactor pressure vessel.

18. The pressurized water reactor of Claim 17 wherein the pipe has a lower end at a height in the at least one suppression tank which limits an amount of water transferred through the pipe to the fluid cavity, leaving remaining water in the at least one suppression tank for gravity flow to the reactor pressure vessel.

19. The pressurized water reactor of Claim 14 including a flow path from the flood-up cavity to an elevation in the reactor pressure vessel above the reactor core through which water in the flood-up cavity flows by gravity into the reactor pressure vessel and keeps the reactor core covered.

20. The pressurized water reactor comprising:

a containment structure;

a reactor pressure vessel containing a pool of reactor coolant;

a reactor core mounted in the pool of reactor coolant in the reactor pressure vessel;

at least one steam generator immersed in the pool of reactor coolant in the reactor pressure vessel;

at least one suppression tank mounted in the containment structure above the reactor core and containing water through which steam escaping into containment from the reactor pressure vessel as a result of a loss of coolant accident is directed and condensed; and

piping for selectively transferring water by gravity from the at least one suppression tank to the reactor pressure vessel to maintain the reactor core covered with water.

21. A method of operating a pressurized water reactor having a containment structure containing an integral reactor comprising at least one steam generator mounted together with a reactor core in a pool of reactor coolant in a reactor pressure vessel and with the at least one steam generator having a secondary loop extending outside of containment, the method comprising:

in response to a loss coolant accident resulting in a mass flow of reactor coolant out of the reactor pressure vessel into the containment structure,

circulating cooling fluid through the secondary circuit of the at least one steam generator to withdraw heat from the reactor pressure vessel; and

extracting the heat from the cooling water outside of containment at a rate which, within no more than about 3 hours, lowers pressure in the reactor pressure vessel to a pressure at or below pressure in the containment structure resulting from the loss of coolant accident and thereby stopping or reversing the mass flow of reactor coolant from the reactor pressure vessel whereby the reactor core remains covered without the addition of water from other sources to the reactor vessel.

22. The method of Claim 21 comprising the further steps of:

including at least one suppression tank containing water in the containment structure;

introducing steam in the containment structure resulting from the loss of coolant accident into the water in the at least one suppression tank to condense the steam; and

selectively transferring water from the suppression tank to the reactor pressure vessel to keep the reactor core covered with water.

23. The method of Claim 22 including mounting the at least one suppression tank above the reactor core and transferring the water to the reactor pressure vessel by gravity.

24. The method of Claim 23 further comprising:

disposing a lower portion of the reactor pressure vessel containing the reactor core in a flood-up cavity in the containment structure;

using gas in the at least one suppression tank above the water, which gas is compressed by the addition of a gas/ steam mixture from the pressurized containment structure to transfer at least some water in the at least one suppression tank to the flood-up cavity.

25. The method of Claim 24 wherein the step of introducing the steam into the at least one suppression tank comprises introducing the gas/steam mixture from the containment structure at a level selected to transfer a first portion of the water in the at least one suppression tank to the flood-up cavity leaving a

remaining portion of the water in the at least one suppression tank for selective transfer to the reactor pressure vessel by gravity.

26. The method of Claim 21 including disposing the lower portion of the reactor pressure vessel containing the reactor core in a flood-up cavity in the containment structure and including at least one suppression tank in the containment structure, introducing steam in the containment structure resulting from the loss coolant accident and gas in the containment structure into the water in the at least one suppression tank to condense the steam, and selectively using the gas in the at least one suppression tank, compressed during the condensing of steam by the gas added from the containment structure, to transfer water from the at least one suppression tank to the flood-up cavity.

27. The method of Claim 26 further including constructing the containment structure from steel and directing a flow of a cooling fluid over an external surface of the containment structure to provide diverse cooling and depressurization of the containment structure whereby steam is condensed on the internal surface of the containment structure and returns to the reactor vessel flood-up cavity where it is available for cooling the reactor core.

28. The method of Claim 21 including:

selectively venting steam from an upper portion of the reactor pressure vessel into the containment structure to ensure equalization of reactor pressure vessel pressure and containment structure pressure at a rate such that following a break in a lower portion of the reactor pressure vessel, reactor pressure vessel water level does not fall below the top of the reactor core.

29. The method of Claim 21 including:

disposing a lower end of the reactor pressure vessel containing the reactor core in a flood-up cavity in the containment structure;

providing a supply of water in the containment structure to fill the flood-up cavity to a level above the top of the reactor core; and

selectively transferring water from the flood-up cavity to the reactor pressure vessel above the reactor core by gravity.

30. A method of operating a pressurized water reactor having a containment structure filled with gas and containing an integral reactor comprising at

least one steam generator mounted together with a reactor core in a pool of reactor coolant in a reactor pressure vessel, the method comprising:

including at least one suppression tank containing water in the containment structure; and

in response to a loss of coolant accident, introducing the gas in the containment structure together with steam in the containment structure resulting from the loss of coolant accident into the water in the at least one suppression tank to condense the steam; and selectively transferring water from the suppression tank to the reactor pressure vessel to keep the reactor core covered with water.

31. The method of Claim 30 wherein the step of including at least one suppression tank comprises mounting the at least one suppression tank within the containment structure above the reactor core, and the step of selectively transferring water comprises selectively transferring water from the at least one suppression tank to the reactor pressure vessel by gravity.

32. A method of operating a pressurized water reactor having a containment structure filled with gas and containing an integral reactor comprising at least one steam generator mounted together with a reactor core in a pool of reactor coolant in a reactor pressure vessel, the method comprising:

disposing a lower portion of the reactor pressure vessel containing the reactor core in a flood-up cavity in the containment structure;

including at least one suppression tank containing water in the containment structure; and

in response to a loss of coolant accident, introducing the gas in the containment structure together with steam in the containment structure resulting from the loss of coolant accident into the water in the at least one suppression tank to condense the steam; and selectively transferring water from the suppression tank to the flood-up cavity.

33. The method of Claim 32 wherein water in the at least one suppression tank is transferred to the flood-up cavity using gas compressed during the condensing of steam in the at least one suppression tank.

34. The method of Claim 32 including transferring some of the water in the at least one suppression tank into the reactor pressure vessel.

35. The method of Claim 34 wherein the at least one suppression tank is mounted in the containment structure above the reactor core and some of the water in the at least one suppression tank is transferred into the reactor pressure vessel by gravity.

36. The method of Claim 35 wherein the gas and steam from the containment structure are introduced into the water in the at least one suppression tank at a level in the at least one suppression tank to transfer a selected amount of the water to the flood-up cavity using gas compressed during the condensing of the steam in the at least one suppression tank and leaving a remaining amount of water in the at least one suppression tank for selective transfer by gravity to the reactor pressure vessel.